This module aims to familiarize Observers with pelagic gillnet vessels, fishing gear and fishing operations as these will be used daily in their routine work.

Trainee performance is evaluated against the following agreed IOTC ROS competency standards:

- Candidate recognises the basic layout of gillnet fishing vessels.
- Candidate is familiar with working and observation areas and common fishing operational scenarios for the pelagic gillnet fisheries.

The achieving of these standard is demonstrated by candidate capacity to:

✓ demonstrate working knowledge of the structure of a gillnet vessel;

✓ recognise (from photos or draws) working and observation areas on gillnet vessels;

✓ be acquainted with the different components of the pelagic gillnet gear;

✓ demonstrate knowledge of general procedures in gillnet fishing operations (setting, hauling, processing).;

✓ able to identify distinct processing and storing methods used.

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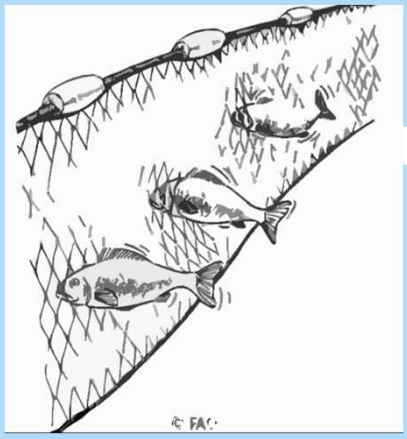
BACKGROUND AND VESSELS

- Gillnet fishing is a passive fishing technique
- Consist of a series of net panels suspended in the water column
- Catches fish that swims into it



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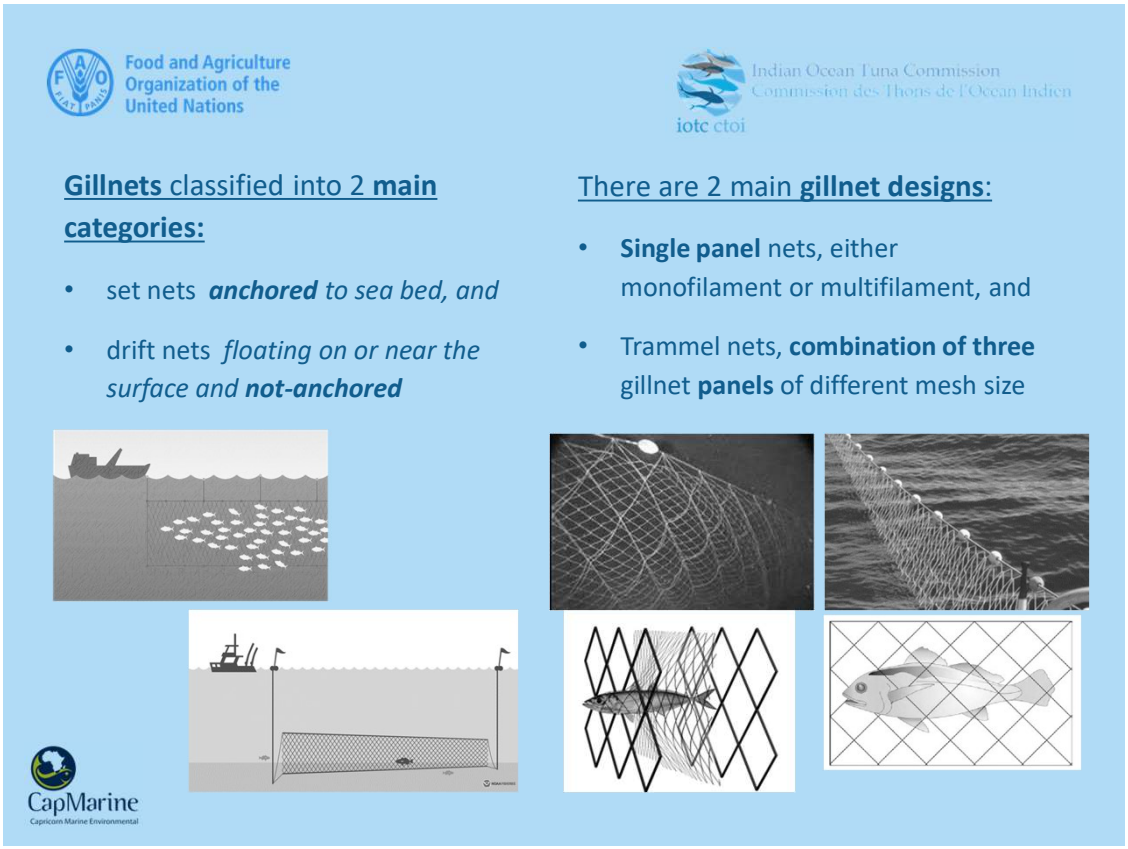
Gillnets or driftnets consist of a series of net panels that are suspended in the water column. It is a passive method of fishing that does not use bait to actively trap fish. The fish swim into the net and become entangled.



Gillnets can be broadly classified into several categories:

- set nets (anchored); and
- drift nets (un-anchored).

There are 2 main designs of gillnets:

- single panel nets, either monofilament or multifilament, and
- trammel nets.

Trammel nets are a combination of gillnets of different mesh sizes consisting of three layers of net. A slack, small mesh, inner panel of netting sandwiched between two outer layers of netting, which are taught and have a larger mesh size. The inner panel may be made of multifilament or monofilament nylon, whilst the outer panels are generally made of multi filament material. Gillnets and trammel nets are widely used all over the world, both in inland and in the marine environment, especially with artisanal fisheries.

Gill nets entangle fish in three different ways: wedging (the fish around the body), gilling (the fish enters the mesh and the net hooks the fish behind the operculum), and tangling (the fish does not penetrate through the mesh, but teeth, fins or other projections get entangled in the net).

In this training module we shall study the configuration and usage of SINGLE PANEL DRIFT NETS.

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- **The IOTC defines large-scale driftnets, as gillnets or other nets or a combination of nets, that are more than 2.5 kilometres** in length whose purpose is to enmesh, entrap, or entangle fish by drifting on the surface of, or in, the water column.
- **The IOTC** Resolution 17/07 ***prohibits the use of large-scale driftnets in the entire IOTC area of competence (high seas and CPCs EEZs).***

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Drift nets were used extensively on the high seas by a number of countries in the 1980's to target tuna. However, they were also associated with high numbers of incidental capture of marine mammals and turtles.

The main IOTC Resolution governing gillnets is Resolution 17/07 to prohibit the use of large-scale driftnets in the IOTC Convention area based on the United Nations General Assembly (UNGA) resolution 46/215 which calls for a global moratorium on large scale driftnet fishing on the high seas.

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Gillnet fishing ranges from artisanal *fishers in pirogues* to industrial vessels operating on the high seas for 3 months at a time

Factors influencing the use of gillnets in the IOTC area:

- low cost of the gear
- operated from small boats manually (little or no powered mechanical gear)
- passive fishery - does not require bait

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Fishing operations involving gillnets contribute to around 35% to the IOTC nominal catches These catches amount to 630 thousand tons of fish. It arises as the most important single fishing gear in terms of volume of catches. On the current (2019) IOTC list of vessels 1306 gillnet vessels are registered in 3 countries (1295 from Iran; 10 from Pakistan; and 1 from France). However, taking the artisanal component of gillnet vessels, 21 countries are reportedly carrying out gillnet fishing in the IOTC area.

The length over all (LOA) of vessels and area of operation are the main factors differentiating the classification between artisanal and industrial gillnetting related to compliance with IOTC resolutions:

- vessels with LOA greater than 24m are classified as industrial both within their EEZ and on the high seas.
- vessels with LOA greater than 15m that operating on the high seas outside their counties EEZ are classified as industrial vessels;
- vessels less than 15m operating within their countries EEZ are classified as artisanal.

The main target species of commercial gillnet vessels is yellowfin tuna and skipjack tuna. However large numbers of bigeye tuna are caught as well as larger billfish species. The indiscriminate nature of gillnet fishing can result in a large range of other neritic species that inhabit the near surface area being caught. These are often the main target species of artisanal fishermen, including smaller tuna like species such as: Kawakawa, Frigate tuna and Longtail tuna.

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BASIC LAYOUT OF A GILLNET VESSEL

- Purpose-built gillnet vessel with hydraulic powered drums positioned on the bow.

- Multipurpose vessel that may operate either longlines or gillnets, with a long roller mounted on the starboard rail.

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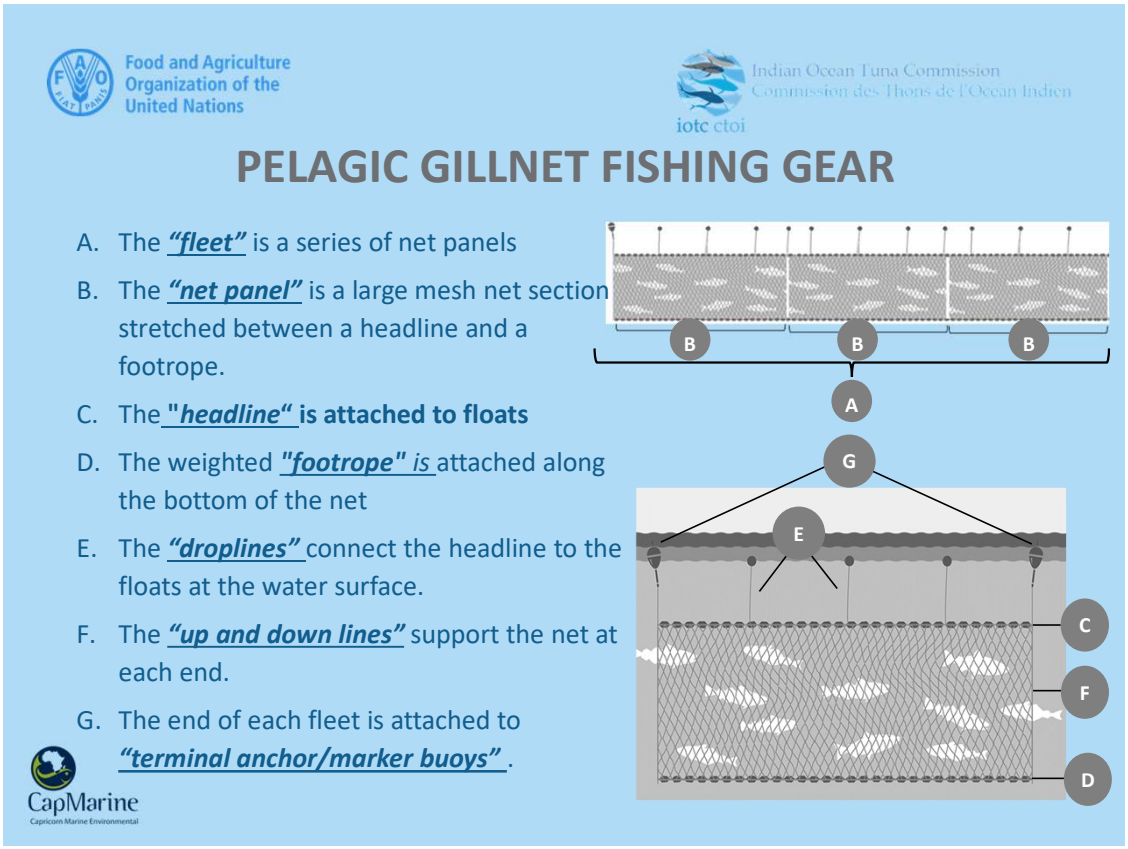
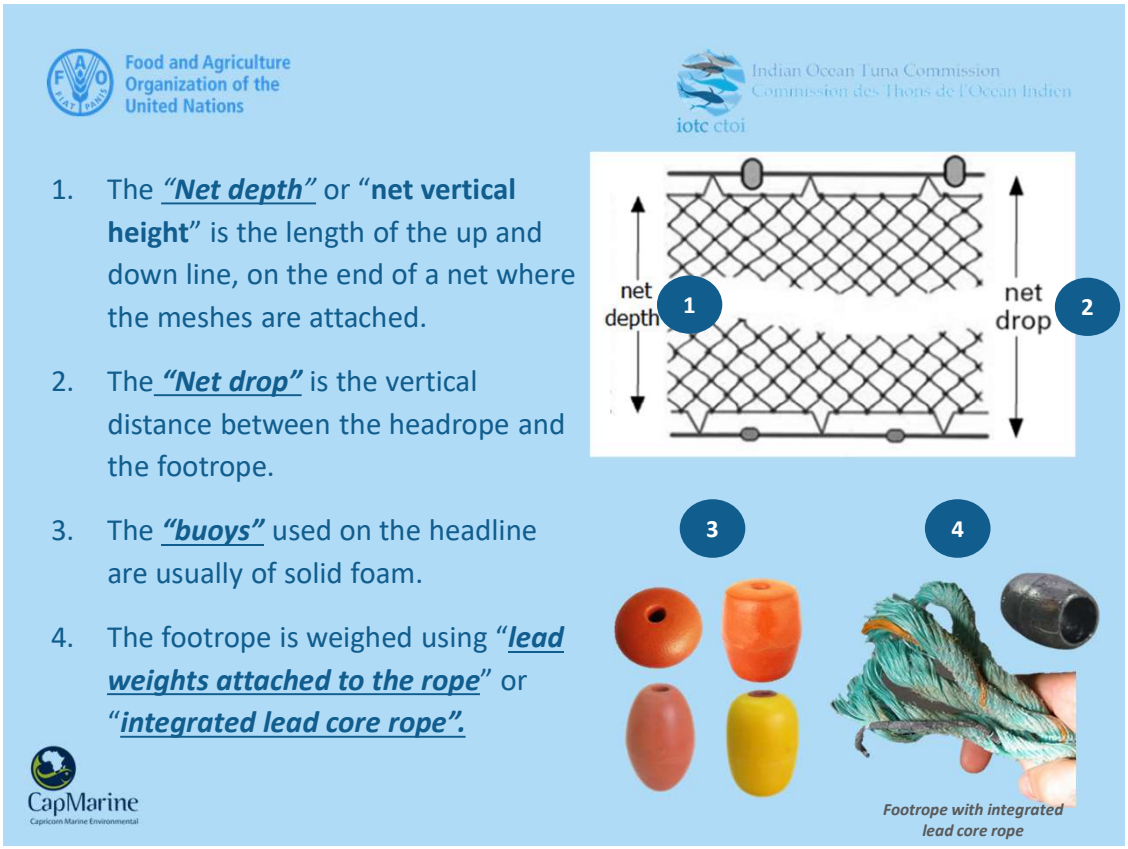
Gillnet vessel layout can vary depending on the size and construction of the vessel. Larger purpose-built gillnet vessels (15m plus) have hydraulic powered drums positioned on the bow from where the nets are hauled and the net is then stored either on the deck forward or in forward holds. The fish are processed on the deck aft of the net haulers. The bridge and accommodation are positioned aft of the vessel. Alternative layouts can be found on multipurpose vessels that may operate either longlines or gillnets. On these vessels the nets are often set and hauled from the starboard side. A long roller is mounted on the starboard rail to facilitate setting and hauling the net.

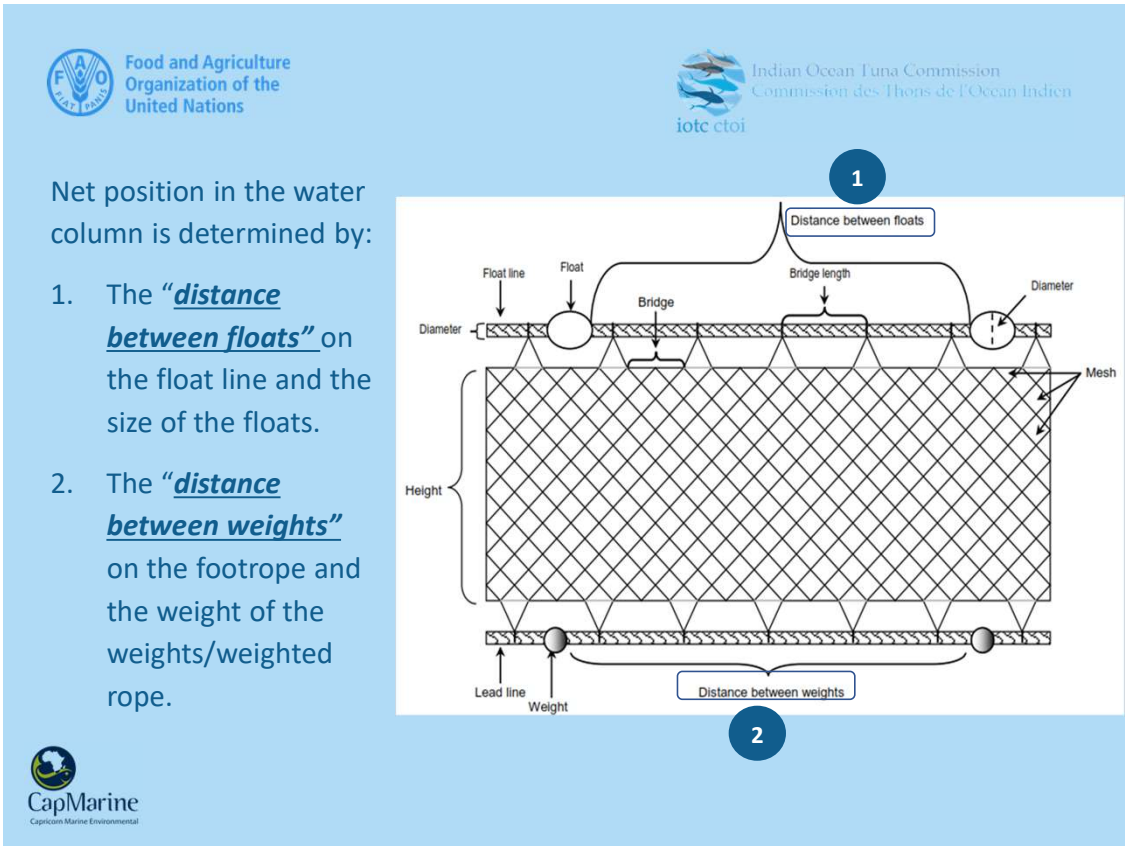
Larger industrial size vessels (LIV), often converted from industrial longline vessels, set the net from the stern and haul it from the starboard side, forward of the bridge. They use an elongated drum mounted on a winch and open on one side. A roller is extended over the side to assist in guiding the net to the hauling drum. A chute or channel is used to guide the net from the hauling point back to the stern where it is ready to set again.



Gillnets are generally made up out of a series of vertical net panels ("***fleet***"). A "***net panel***" being a large mesh section of netting stretched between a "***float line***" at the top (or "***top rope"***, or "***headline"***) and a "***lead line***" at the bottom (also called "***weight line***" or "***footrope***"), and supported by vertical "***end lines"***, or ***"up and down lines"*** on each end. The net ***"panel"*** (or ***"skein"***) can be of variable length, depths, mesh sizes and materials obtainable from net manufacturers. The headline is attached to the top row of meshes and connect net panels in a continuous net (fleet). The headline is connected to the floats that stay at the water surface with "***droplines***". The beginning/end of each fleet is attached to ***"terminal anchor/buoys"*** (similar or the same as those used to mark the ends of a longline).



The "**net depth**", "net vertical height" (or "net depth"), is the length of the end line, or up and down line, on the end of a net where the meshes are attached. The net depth should not be confused with the **"net drop"**, which is the vertical distance between the headrope (headline, float line) and the footrope (lead-line). The **"buoys"** used on the headline, (float line) are usually solid foam, oval or cylindrical buoys. The footrope is weighed using "**lead weights"** attached to the rope or "**integrated lead core rope"** (i.e. weighted rope).



The size and spacing of floats on the headline and weights of on the footrope will also vary depending on where the net is to be positioned in the water column. Observers should be familiar with both these aspects and be able to measure and record these specifications if requested.

The net material can consist of either monofilament nylon or multifilament twine materials. Note that different net colours can have an impact on cetacean and turtle bycatch as some colours are more visible than others [Consistent with SC16.24 (para. 53)].

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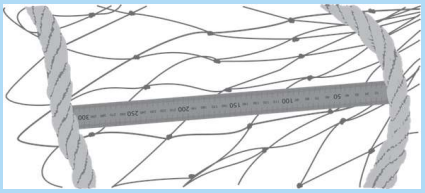
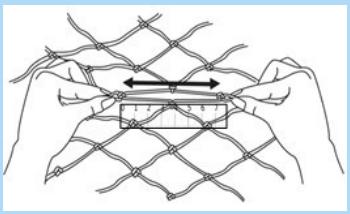
Single net panels can be highly selective since they can target fish of a specific minimum size by regulating net

- **mesh size**, and
- **hanging ratio**



The **mesh size determines the *size of the fish caught***

- *Fish smaller than the mesh pass through*
- *Larger fish bounce off the net*



Adapted from SPC image

The size of the mesh can be determined by stretching the mesh and measuring the distance from knot to knot in either centimetres or millimetres.

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Single net panels can be highly selective since they can be set to target fish of a specific minimum size by regulating the net mesh size, and the net hanging ratio. The mesh size determines the size of the fish caught as fish smaller than the mesh passes through it and larger fish bounces off the net if the net panel mesh tension is high. The size of the mesh can be determined by stretching the mesh and measuring the distance from knot to knot in either centimetres or millimetres.

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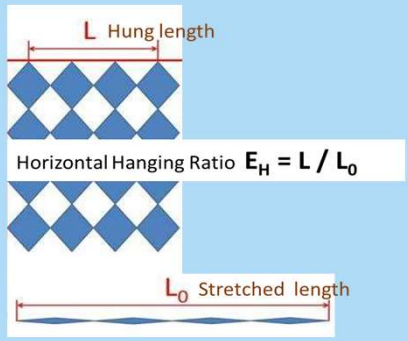
The **hanging ratio determines the depth and *mesh tension*** on a panel of net.

Hanging ratio (E) is defined as the length of a rope on which a net panel is mounted (L) divided by the actual length of stretched netting on the rope (Lo).



Catching round fish such as tuna and tuna like species typically have hanging ratios between 0.4 and 0.5.

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The hanging ratio of a gillnet is one of the most important factors affecting catches since it determines the tension of the mesh of the net and its depth. The horizontal hanging ratio (EH) is the ratio between the length of the float line (L) and the length of the stretched mesh hanging on the float line, also called hung length or bridge length (Lo). Hanging ratios of 0.5 or higher, have more tension on the net panel and are more selective in the size of fish caught. A ratio less than 0.5 results in a “slack” net with less tension, with a reduced selectivity and tendency to catch smaller fish or easily entangle larger fish. When nets are constructed with a hanging ratio of 0.5 or slightly higher, they have more tension on the net panel and tend to be more selective in the size of fish caught.

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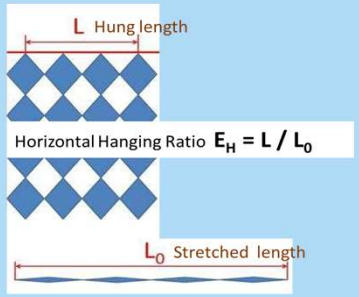
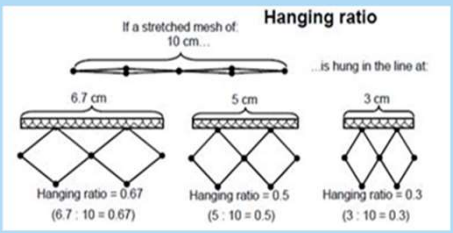
Hanging Ratios: Practical Example

- record the spacing of a selected number of attachment points of mesh on the float rope
- divide this by the stretched length of the same number of meshes



Spacing of 2 mesh attachments = 6.7 cm
Stretched mesh length = 10 cm
Hanging ratio 6.7 / 10 = **0.67**

(relatively slack net and less selective)



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The horizontal hanging ratio (EH) can be calculated by dividing the hung length (L) of a single mesh by its stretched length (L0), (measured from knot to knot). EH = L / L0. An example is provided in this slide. Observers will be requested to calculate and record gillnets average hanging ratios.

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DRIFT GILLNET FISHING OPERATIONS

Nets can be operated in different ways depending on the vessel layout

- set and hauled from the side (normally starboard)
- set and hauled from the stern
- deployed over the stern or side and hauled over the bow or side

Nets can be operated by hand or using hydraulic net haulers and/or net drums depending on vessel size. Large drums can also be used to haul and store nets.

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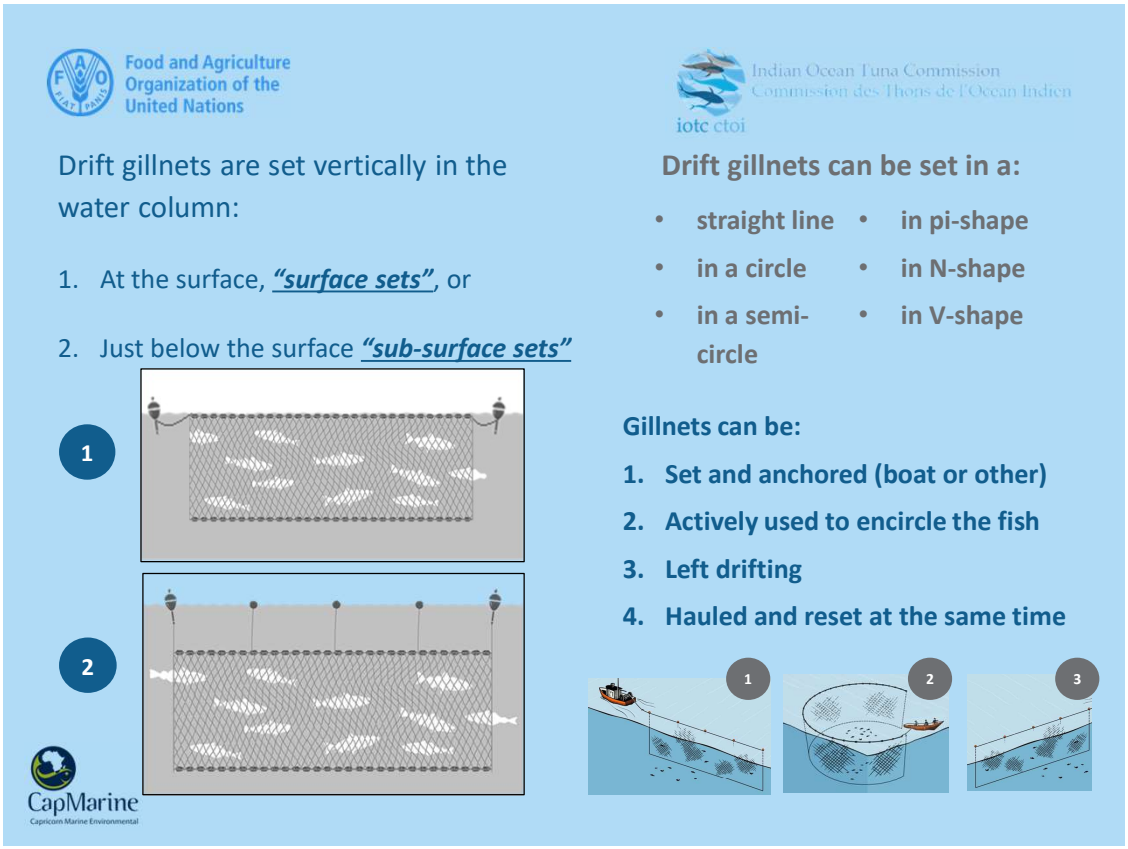
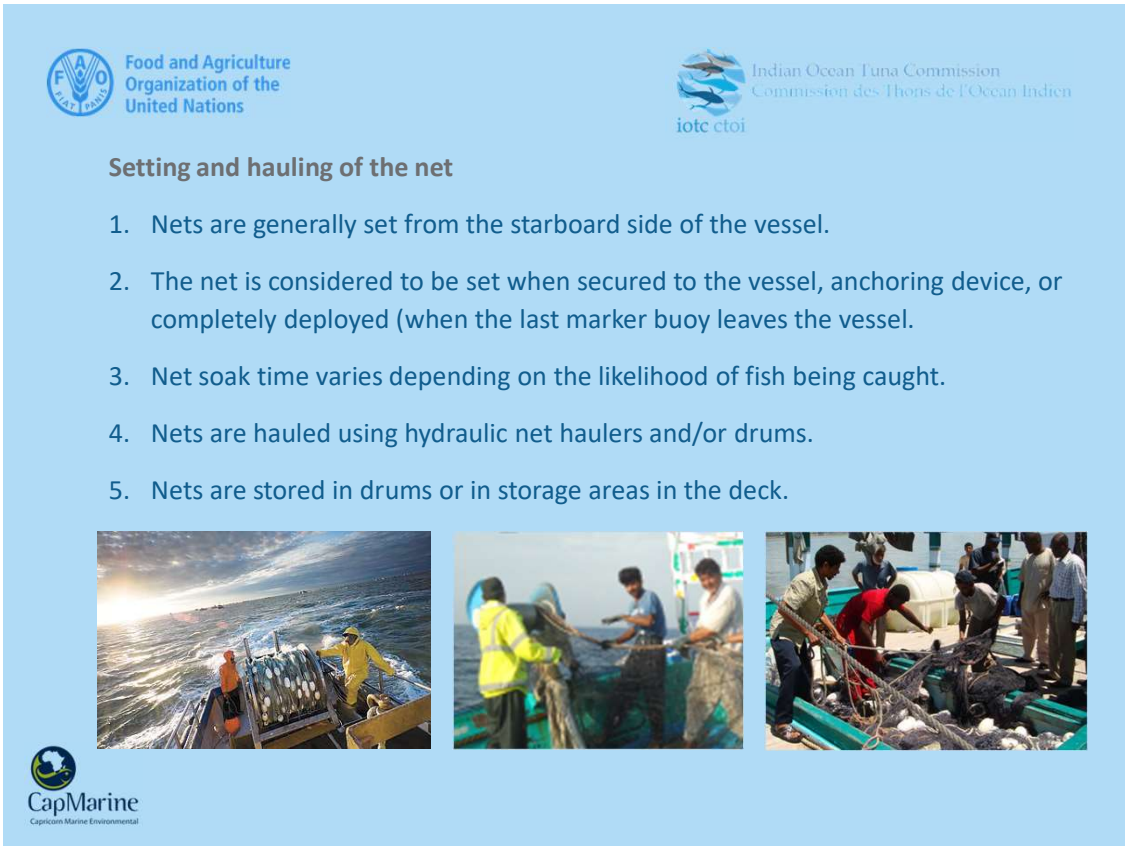
Nets can be operated in different ways depending on the vessel layout. Therefore, Observers will need to choose their net hauling observation area and their biological sampling area according to the vessel configuration.

On small boats, gillnets are operated by hand while hydraulic net haulers and/or net drums are used on larger vessels to handle and store nets.



Drift gillnets may be set at the surface or just below the surface. The level at which the net is set at vertically in the water column impacts levels of bycatch of ETP species. During **'surface sets'**, the gillnet is maintained on the surface of the sea with the help of floats placed closely together along the float line (e.g., around every 4.5 meters), while weights are loosely spaced along the footrope (e.g., around every 60 m). This arrangement enables the net to remain at surface. During **'sub-surface sets'**, droplines of 1.5 to 2 meters long are attached to the gillnet headline at regular intervals (e.g., around every 8 meters), while weights are more tightly spaced along the footrope (e.g., around every 35 m). This arrangement enables the gill-net to remain 2 meters below the surface during the fishing operation.

The gillnet can be set in a straight line across the prevailing currents, in a circle, i.e. around, encircling a shoal of fish, in a semi-circle, in pi-shape, in N-shape, or in V-shape. The gillnet can be anchored (attached to the boat or other), left drifting or actively used to encircle the target school. An alternative fishing strategy is to ride along the net so that it is hauled and reset at the same time and fish are removed as the net is hauled. This has the advantage of keeping the net in the water and removing catch before they deteriorate.



Nets are generally set from the starboard side of the vessel, a raised section like and inverted “V” can assist in keeping the weighted and floating lines apart. The vessel speed determines the rate at which the net is set. Danbuoys with lights attached are used to buoy off the ends of the net. On longer sets, the additional marker buoys can be attached.

Once the net is set, it is left for a predetermined soak time. Soak times are likely to vary depending on likelihood of fish being caught. As the fish quickly die in the net, they start decomposing and longer soak times can thus affect the fish quality. There is also the risk of secondary predation if soak times are too long.

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Processing and Preservation of the Fish

- **Ice** - Artisanal vessels – Fresh whole fish – Trip duration of 1 to 5 days.
- **Ice + Cold Storage Facilities** – Larger powered vessels – Fresh fish processed according to the species, gill and gutted or head off – Trip duration 10-15.
- **Frozen + Refrigeration Facilities** - Larger vessels that can fish on the high seas – Frozen fish processed according to the species, gilled and gutted or head off – Trip duration 60-90 days.

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Factors that influence the processing and preservation of the fish are the size of the vessel and its range. Processing takes time and needs space, and this can be limiting on smaller vessels. Larger powered vessels have ability for refrigeration for keeping either fresh or frozen fish for several weeks or months if frozen. Whereas artisanal vessels may undertake trips of only a 1 to 5 day and fish can be kept on ice. On larger vessels with refrigeration, the fish may be processed according to the species - gill and gutted or head off. Smaller tuna species are often frozen whole (round) similar to that on purse seine vessels. Smaller vessels are more likely to land fresh fish, unprocessed.

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